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GEOPHYSICAL VARIABLES AND BEHAVIOR: XII. THE WEATHER MATRIX ACCOMMODATES LARGE PORTIONS OF VARIANCE OF MEASURED DAILY MOOD

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Summary.—Multiple regression lag analyses demonstrated that four to five major components of the weather matrix accommodated approximately 30% to 60% of the variance in daily mood scores for 5 male and 5 female university students over either a 2- or 3-mo. period. Between 10% and 30% of this variance was also explained by day-of-the-week for 4 subjects. Optimal values from the weather matrix occurred about three days before mood measures. Two of the most frequent variables were geomagnetic variation and mean barometric pressure. Temperature, which was contaminated by serial correlations, could be substituted by other variables. Standard errors of the estimate for the equations ranged between 8% to 15% of the mean mood measures. However, equations for three of the subjects' predicted scores were significantly correlated with the observed scores for the 10 days and to a lesser extent the 20 days after the period used to generate the equations.

Associations between weather and mood are common references in contemporary folklore (Persinger, 1980). Since human learning is dominated by the principles of temporal contiguity, "common sense" weather-mood pairings would probably involve intervals of not more than 24 hours. The actual control variables may in fact have occurred several days before the reported mood. Such lags are likely in light of the intimate relationship between mood and the autonomic nervous system which is known for its response latency (Tromp, 1963).

In a previous study by the first author (Persinger, 1975), bivariate correlations were calculated between the daily averages of four mood measures and each of several weather variables lagged from 0 to 7 days. A single weather variable accommodated about 10% (maximum 35%) of the variance in mood measures and the maximum correlations occurred between mood and the weather measure during the previous one to two days. However, recent evidence suggests that weather should be considered as a temporal matrix (Persinger, 1980) whose components can add or substitute their effects upon living systems. The present study is a re-evaluation of previous data in this context.

The daily means of four mood measures (recorded before meals and bedtime) from the Dorland scale (Range 0 to 10) were obtained from a previous study (Persinger, 1975) for five female and five male university students who recorded their evaluations for course credit between 9 January and 8 April, 1974. Components of the weather matrix (independent variables) were daily: mean temperature, absolute change in temperature from the previous day, range in temperature, relative humidity, average wind speed, sunshine hours, mean barometric pressure, absolute change in pressure from the previous day, A_p indices (a measure of geomagnetic disturbance), the percentage change in A_p from the previous day (truncated at 200%), solar radiowave emission (2800 MHz), precipitation, and sunshine hour change (the difference in hours from

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the mean of the previous three days). Other variables included time (sequence number) and day-of-the-week. All variables were lagged from 1 to 7 days.

Using the REGRESSION program from SPSS on a DEC 2020 System computer, all variables (except mean temperature which was correlated with time) were entered for each of 10 equations (subjects). Selection criterion was based on the asymptote for the change in r^2 values at 1% to 2% and usually involved three to seven variables. These variables were then included in a separate run for the final equations. For the first period of analyses, which involved 45 days (Jan. 15 to March 1), the averaged adjusted r^2 was 41.5%; the range was 20% to 64%. Day of week entered as a significant variable for four subjects and singularly explained between 14% and 25% in score variance (day of week effects were optimized for each subject by finding the maximum slope through lag analysis: for 9/10 subjects the maximum occurred on Fridays or Saturdays while the minimum involved Sundays or Mondays). The average lag value for the top two weather variables to enter the equations was 3.1; the lag average for all weather variables was 3.4.

For comparison, all variables and their lags were allowed to enter for a larger period (60 days). Using the same change in r^2 criterion, a total of four to six variables entered for each subject (without temperature but with sequence number). Adjusted r^2 values indicated that 40% of the variance in mood scores was influenced by the weather matrix; the range was 28% to 57% (multiple Rs were 0.53 to 0.79). The most powerful variables of each equation were mean barometric pressure (lags of 2 to 4 days), A_p indices (lags of 1 to 3 days), and sunshine hours (no lag). Day-of-the-week was entered for the same four subjects and explained between 12% and 18% of the variance. The average lag number for the first two weather variables that entered the 10 equations was 2.6 and the two most common variables were barometric pressure (for seven subjects) and the A_p indices (five subjects).

The addition of mean temperature measures to either analysis period and the deletion of sequence number from the variables did not appreciably alter the adjusted r^2 values for nine of the subjects. Only one subject, who had been influenced by sequence number (20% to 28% of variance) demonstrated an elevated adjusted r^2 value comparable to the other subjects once temperature entered. A lag of mean temperature entered for four subjects but in only two instances were they within the top two variables. Neither sets of analyses contained intercorrelations between variables of more than 0.50; only three Durbin-Watson tests fell outside 2.0 ± 0.05 and all F values (> 7.50) were statistically significant ($p < .001$). The variable matrix for a given subject did not change appreciably for the analysis intervals. Portions of the analyses were completely independent by each author and confirmed.

The capacity for equations generated from the two intervals to predict scores was tested by correlating the observed mood scores for the consequent 10 and 20 days with the predicted scores generated by the equations. These correlations were significant statistically (rs between 0.45 and 0.60) for only three of the subjects and primarily for the 45-day interval. Intercorrelations between the predicted-observed correlations, mean mood score, standard error of the estimate divided by the mean mood score (which ranged from 8% to 15%), standard deviation around the mean, multiple Rs and Durbin-Watson scores were evaluated. In addition to the expected relationships between dispersion measures, a negative correlation (-0.87) between the mean mood score for each subject and the predictive (correlation) accuracy was observed. We concluded that the subjects with lower mean scores demonstrated more systematic and predictable responses to the weather matrix than subjects with higher scores.

These analyses indicate that an average 40% of the daily variation in mood evalua-

tions can be accommodated by optimal components of the weather matrix. Like the previous bivariate study, the equations were dominated by barometric pressure and geomagnetic measures. The inclusion of day-of-the-week added a separate source of variance for four subjects. Standardized residual profiles for each subject (equation) strongly indicate that inclusion of social events within the analyses could accommodate even more of the daily variance of mood measures.

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